Inception Report

December 2015

Study on Economic Costs of Natural Gas for Myanmar Domestic Market

Submitted to:

Rome Chavapricha
The World Bank

Submitted by:

e.Gen Consultants Ltd.

Project Document

Economic Costs of Natural Gas for Myanmar's Domestic Market:

Inception Report

December 2015

This report was written by Saad Agha, Evangelos Penglis, and David Roland-Holst, under the supervision of Faisal Rabbi.

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E. Gen Consultants, Ltd.
14A Chandrashila Suvastu Tower, 69/1 Bir Uttam Qazi
Nuruzzaman Road, Panthopath, Dhaka 1205 Bangladesh
www.e.Gen.com

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Note: In this publication, the symbol "$" refers to US dollars.

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ABBREVIATIONS[1]

ADB – Asian Development Bank

ASEAN – Association of Southeast Asian Nations

CDM – Clean Development Mechanism

CNG – Compressed Natural Gas

DCF – Discounted Cash Flow

GHG – greenhouse gas

GMS – Greater Mekong Sub-region

ICT – information and communication technology

LNG – Liquified Natural Gas

MDGs – Millennium Development Goals

PRC – People's Republic of China

SMEs – small and medium-sized enterprises

WB – World Bank

$ - United States Dollars

[1] A glossary of technical terms is available in an appendix at the end of this document.

1 INTRODUCTION

1. Myanmar energy consumption is among the lowest in the world. About 70 percent of the population has no access to electricity, and the consumption per capita is 160 kWh per annum, twenty times less than the world average. Most rural areas lack electricity services - only 16 percent of rural households have access to grid-based power. Access to modern fuels for cooking (such as LPG) is limited to urban areas, with the countryside relying on traditional biomass (fuelwood and animal dung), comprising about two-thirds of Myanmar's primary energy consumption.

2. To support evidence based development strategies for the nation's energy sector, the World Bank has commissioned this study of the economic costs of natural gas development and distribution in the domestic market. Natural gas can be a potent catalyst for economic growth and livelihoods improvement, but as a direct energy source and feedstock for relatively low emission electric power generation. For their part, Myanmar authorities are interested to review the economic cost of supplying natural gas for domestic consumption to better prepare for the rising domestic demand for gas. An updated gas costing exercise can support effective decision-making on leading energy policy decisions, including but not limited to balancing gas export and domestic consumption, domestic gas pricing, including tariffs and/or subsidies.

3. The first objective of this study will be to determine the economic costs of supplying natural gas into the domestic market at certain offtake points of the gas network considering Myanmar's gas reserve position and current and forecasted supply and demand conditions. The second objective will be to review the impact of international gas prices on Myanmar's gas exports and government's revenues from the gas sector. This document summarized the inception of the cost assessment project, including initial engagement with national counterparts, data gathering, and proposed methods of assessment.

2 DATA RECONNAISSANCE

5. The project was initiated with a comprehensive review of information resources needed for the cost assessment, supported by an initial data reconnaissance mission to Nay Pyi Taw in November, 2015. Time and resource constraints for this project do not allow for primary data development, so we focused on existing secondary sources in public and private hands. Our first objective was to catalog all publicly available data, with some rapid assessment of its completeness and reliability.

6. Among the public sources, the primary source was the Ministry of Energy (MOE) of the Government of the Union of Mynamar (GOM), but other public sector contributors included other line ministries, the Central Statistical Office, and a variety of multilateral and bilateral institutions. For the private sector, independent national operators are limited, but GOM has some large foreign partners who could make data available.

7. Three generic types of information were sought, corresponding to different stages of the energy supply chain, as well as some data on the overall national, regional, and global economies. In all cases, sourced data on actual and historical volumes, capacity, and as much cost/price detail as possible:

1. Exploration, extraction, and refining.
2. Distribution, storage, and logistics, in terms of location, volumes, and capacity, with attendant infrastructure investment and O&M costs.
3. Demand side data by detailed end user type (electric power, industry, household, etc.).

We also considered the five most significant types of institutional actors associated with Myanmar’s energy system, listed in the table below.

Table 1: Primary Data Sources

1. Government of Myanmar • Our first line of enquiry, since GOM line ministries and SOEs may hold much of the data developed by others
2. Multilaterals • WB, ADB, and some other multilateral development banks may have researched Myanmar energy in support of development policy or lending (particularly for energy infrastructure). We should review their commitments and attendant information resources. • IEA: We reviewed the reporting standards for Myanmar and the data available
3. Bilaterals • A number of Myanmar's leading development partners (JICA, USAID, USEIA, China Development Bank, etc.) have researched the country's energy system for their own investment interests or to support lending. We conducted a rapid review of these sources and information they may have produced.
4. Private sector • This group can be challenging because of incentives to limit disclosure, but we can begin with Myanmar line ministries who may be auditing the activities of energy system investment partners. Either they would have records of joint and individual venture investment & operations or they could help us request this information.
5. Demand side sources • In this case, the primary source would be the utilities who are delivering gas. As part of our reconnaissance of publicly available data, this was a high priority. Despite uncertainties regarding the level and (especially) composition of gas allocation to industry and households, we hoped the electric power distributors have accounts that can be audited. For leading industries and institutions (e.g. the military), specific requests could also be helpful. For household use, we acquired a very good nationally representative household survey of Myanmar for 2012. Of course, the reason for this WB project is that Myanmar has extremely low HH gas use, so this can't be a big factor in calibrating our models. It would, however, support detailed assessment of gas policy's livelihoods potential.

2.1 Detailed Data Requirements

8. In Section C of comments on the project Terms of Reference, e.Gen set forth a list of detailed data requirements. With respect to the sources described above, these were our primary targets in

the reconnaissance. Annex 1 for details these 43 entries and their availability, and we summarize them below.

1. Studies and data requirements regarding gas supply and demand:

1. Proven, possible and probable gas reserves.
2. Latest gas reserves audit report. If a recent audit is not available, then up-to-date unaudited information on the proven, possible and probable reserves in Yadana, Yetagun, Shwe and the smaller on-shore fields. Information, inter alia, should include for each gas field reservoir depth, water depth, total reserves, expected peak production, ultimate gas recovery, estimate of developed and undeveloped field potential
3. Current and planned Production Sharing Agreements (PSAs) with gas producers
4. Historical, current and forecasted gas production. Historic data for gas production (annual and yearly peak) should be by field
5. Historical, current[2] gas exports, forecasted exports based on commitments/contractual arrangements and plans/targets
6. Historical, current gas exports in spot markets
7. Historical, current domestic gas supply, and projected availability of gas for domestic use
8. Historical and current commercial and technical losses in gas production, transportation and distribution. Potential changes in commercial and technical losses as result of relevant actions
9. Historic data for the operation of the gas transmission and distribution systems (daily inflows at each injection point and outflows at each off-take point)
10. Historic data for the operation of the export pipelines (daily outflows)
11. Detailed description and technical characteristics of gas infrastructure in Myanmar (including map). Infrastructure will include production platforms and gas processing plants, gas transmission and distribution systems (length and diameter of pipelines, compression stations, metering & regulation stations, maximum and operating capacity of pipelines, location and capacity of injection and off-take points), export pipelines (length

[2] Current year refers to the latest full year for which data is available (2014). Historic data requested for the period 2000 – 2013. Forecasts refer to a period of 2015 – 2025.

and diameter of pipelines, compression stations, metering & regulation stations, off-take points, maximum and operating capacity)

12. Investment plans for development of new gas infrastructure (transmission and distribution systems, export pipelines, LNG terminals, storage facilities), with information including inter alia planned maximum and operating capacity, status of implementation, planned date commissioning. Available studies (e.g. pre-feasibility, feasibility studies) for each planned infrastructure
13. Description of Myanmar's key gas consumers (electricity production, industry, transport, distribution), their location, their typical daily load profiles in different months, monthly consumption
14. Gas demand forecasts per sector, including all scenarios, key policies and drivers.
15. Description of electricity sector of Myanmar (gas-fired power plants [type, capacity, year of commissioning, annual hours of operation, efficiency factor], other power plants [including RES]. Electricity peak demand, generating capacities, gross electricity production, transmission and distribution losses (commercial/technical), own power sector consumption
16. Electricity sector investment plans, and underlying rationale and drivers behind the investments to be made (efficiency of existing plants, new CCGTs, Open Cycle plants, network extensions etc) for validation of gas demand forecasts in the electricity sector (e.g. commissioning/decommissioning of plants, upgrades of existing plants, electricity system extensions, loss reduction plans, etc)
17. Description of use of CNG in transport (number of filling station and Natural Gas Vehicles, CNG price evolution, policies promoting the use of CNG)

2. Studies and data requirements regarding cost of gas production, transmission, distribution and supply:

18. Agreed off-take points for calculation of gas supply costs to customers
19. Gas production (dry) historic and future costs for each gas field (existing or new) broken
20. down by main cost component (exploration & development costs, O&M costs (materials and labour), gas processing and treatment costs (wet to dry), capex, assets depreciation rates, net book value, royalties and taxes (if not included in the PSAs))
21. Thailand and China border with Myanmar gas prices
22. Gas transmission system capex/investment programme
23. Gas transmission system assets (gross, depreciation, net)
24. Gas transmission system O&M costs
25. Gas export pipelines capex/investment programme
26. Gas export pipelines assets (gross, depreciation, net)
27. Gas export pipelines O&M costs
28. Gas distribution system capex/investment programme
29. Gas distribution system assets (gross, depreciation, net)
30. Gas distribution system O&M costs

3. Economic/financial/fiscal data requirements:

31. GDP, nominal, real, PPP, projections Inflation rate (CPI), projections
32. Population, growth rate and projections, urban vs rural
33. GDP per head, average monthly salary
34. Monthly average energy cost, absolute terms and as a % of income), households vs industry
35. Corporate tax rate, projections
36. Local currency exchange rate to USD, projections
37. Depreciation rates for assets
38. Historic and current proportion of debt and equity in total liabilities of the gas operations of Myanmar Oil and Gas Enterprise, as well as the cost of debt and equity, broken down

at production, transmission and distribution levels (for WACC calculation). In case WACC is regulated, the regulated WACC is sufficient for the analysis.

2.2 Inception Mission

2.2.1 General Information

a) Mission date(s):1-5 November 2015

b) Mission to Nay Pyi Day, Myanmar

c) Activity - Introductory consultative Meetings with World Bank and line Ministry of Energy counterparts, followed by intensive data gathering in collaboration with technical staff at various energy sub-ministries.

d) Mission member(s): Dr. David Roland-Holst – Project Lead Economist, Mr. Faisal Rabbi, Assistant Manager of e. Gen

e) Mission's brief TOR - This mission was undertaken to introduce our project to line ministry counterparts and collaborate with their technical staff to fulfil data needs for the project's empirical deliverables.

f) Names, titles of individuals contacted during the mission

World Bank

- Rome Chavapricha, Senior Energy Specialist
- Habib Rab, Senior Country Economist
- Myoe Myint, Energy Specialist
- May Thet Zin, Country Economist

Ministry of Energy

- U Pe Zin Tun, Permanent Secretary
- Tin Zaw Myint, Assistant Secretary
- Zaw Myint, Executive Geologist
- Nu Nu Yi, Finance Department
- Wio Ahrar Mein, Assistant Production Engineer
- Various delegated technical intermediaries

Central Statistical Office

- Daw Marlar Aung, Deputy Director General

- Various delegated CSO staff

2.2.2 Description of Mission Achievements/Tasks Completed

9. During this visit we had an introductory meeting with leadership and technical staff of the Ministry of Energy (MOE), a series of intensive meetings with technical staff to discuss and exchange data, and mission wrap-up meeting. An independent meeting with leadership of the Central Statistical Office (CSO) was also arranged.

Consultative Meeting with MOE

Agenda Summary:

- Introductions
- Overview of project objectives and deliverables
- Discussion of standards for technical staff support and confidentiality of data sources
- Discussion of project timeline
- Overview of meetings with technical staff and follow-up

Specific Issues Discussed:

- Mr. Tin explained the local arrangements for data support, including provision of a meeting room and delegation of technical staff to provide primary data for us.
- Mr. U Pe cautioned that Production Sharing Agreements were bound by confidentiality rules, but that we could make specific data requests that might be approved.
- e.Gen Staff summarized the overall project, data requirements, and deliverables.
- MOE leadership emphasized their desire for user friendly, transparently **documented** decision tools.

Meetings with Technical Staff

- We had three intensive meetings with technical staff and two follow-up meetings, reviewing available data on reserves, production, distribution, costs, and related project finances. In every area staff were completely forthcoming and we we able to obtain up-to-date digital data resources representing all the major categories of our needs.
- All data were provided in response to our specific requests, either at the inception subsequent meetings, in formats that enabled us to transfer the data to our own devices and

take it with us at the end of the mission.

- Finally, we established good collaborative ties with individual technical staff, obtaining assurances of follow-up data support as needed.

Meeting with Central Statistical Office

10. The CSO meeting was a introduction to senior staff, with an eye toward follow-on data requests. Deputy Director Marlar was very gracious and receptive. She also allowed us to examine a hard copy of the new Myanmar Statistical Handbook (2013-14), which is to be made public in December, 2015.

Meetings with World Bank Staff

11. In addition to daily planning and debriefing meetings, we had a teleconference with Dr. Rab and Ms. Zin to review overall project strategy, progress, and economic data requirements that might be met from sources at the resident mission.

2.2.3 Assessment and recommendations regarding counterpart questions and stated interest

12. Thanks to sustained relationship development by our World Bank counterparts, we had very productive consultative meetings and site visits. Going forward, we plan to continue collaborating closely with technical staff across MOE sub-ministries. This will facilitate our timely data gathering and build awareness of and familiarity with the deliverable capacities we are developing. With strong endorsements from their own leadership, we are optimistic about sustaining the constructive engagement that will be needed for them to implement our decision tools and support more effective energy policy research, design, and implementation.

13. As our analysis and tools progress, the e.Gen team will coordinate with our WB team staff to provide technological instruction for all MOE selected staff. Subject to MOE approvals, e.Gen proposes to work with technical officers identified with appropriate technical skill and occupational relevance to our support activity.

14. After developing our research results and decision tool prototypes, e.Gen will propose a schedule and develop a cost estimate for training and dissemination activities, circulating this to ensure local support from relevant implementing agents.

2.2.4 Additional Information, Lessons Learned, Partnership Possibilities Emerged as A Result of Networking Activities

Partnership planning

15. Based on this mission, we plan to recommend a new Myanmar counterpart to support e.Gen locally. This individual will be personally responsible for our our direct dialog with MOE and must be highly knowledgeable about the Myanmar energy sector. We are interviewing candidates at the present time and hope to choose one by the end of December.

2.3 Appraisal of Data Acquired

16. Thanks to close and continuous collaboration with our official national counterparts, as well as supplemental material from the World Bank Resident Mission, we were fortunate to fulfill most of our data requirements. Most information was in electronic format, which will also substantially expedite our progress with the overall cost assessments. Annex 1 below details the characteristics of information resources we acquired for each of the 43 target categories. Generally speaking, the mission was quite effective, again largely thanks to local facilitation. A few general caveats apply to the overall data resource in its present form, however. We list the main unresolved data issues below and are working with our partners to address them.

Table 2: Remaining and Additional Data Issues

1.	A small but significant number of sources include Myanmar language information that needs to be translated for effective utilization.
2.	The capacity of each of the target off-take points (mcf per day)
3.	The number and demand characteristics (max. daily demand, energy demand) of the customers connected to each off-take point
4.	Net assets corresponding to the domestic transportation system, if possible disaggregated by sections corresponding/feeding to each off-take point
5.	Long term Investment plan for the upgrade and expansion of domestic transportation system infrastructure
6.	Identification of transportation system section(s) dedicated to exports
7.	The definition of the gas field(s) that supply each of the target off-take point(s)

8. Details on the mechanic of operation of on-shore (if any) and off-shore PSAs, with regards to rights, obligations of MOGE and foreign partners, participation of MOGE as an equity holder in costs of the PSAs, accounting treatment of PSA projects. Also, mechanisms for sales of gas from PSAs and relevant 'fair market prices' as well as compulsory provisions for foreign partners to allocate % of profit gas at a discounted price to Myanmar's domestic market (domestic requirements)
9. Historic Operating and maintenance costs for the transportation system, for at least 5 years, and available projections, excluding costs related to parts of the transportation system dedicated to exports (if any). Financial statements of MOGE (for year ending 31st March 2015) made available to the Consultant have repair and maintenance costs all bundled.
10. Historical, current, and modeled PSC contracts for gas fields in Myanmar. This information would help us to come up with the most appropriate fiscal regime which correctly represents the current terms in Myanmar. This will ultimately impact the government revenue forecasting accuracy. We will make specific requests according to need.

3 METHODS OF ASSESSMENT

17. The project Terms of Reference stipulate four primary tasks and corresponding deliverables. For each of these, we have developed recommended assessment and analysis methodologies, and summarize each of these in this section.

3.1 Task 1: Review Myanmar's Natural Gas Supply and Demand Balance

3.1.1 Task Description

18. Under Task 1 the Consultant will consider and assess all relevant data and information on reserves and gas supply and demand conditions for the next 10 years or longer.

19. The task will require the review and assessment of proven, possible and probable gas reserves, export commitments, Production Sharing Agreements (PSAs) and domestic gas supply and demand conditions.

20. All relevant data and information on the gas reserves, contractual arrangements and studies on current and future supply and demand conditions will be provided by the MoE to the Consultant after signing the appropriate confidentiality agreement. In addition, the Consultant will review all relevant publicly available information and data to carry out the task.

21. The Consultant shall not audit gas reserves or carry out new gas demand and supply studies. The Consultant will independently review existing studies, contracts and data and based on its findings will prepare an economic analysis proposing the most appropriate approach for calculating economic costs for selling natural gas into the domestic Myanmar market

3.1.2 Overall Approach

22. This task will be completed in two phases. The first will entail a comprehensive review of historical evidence on Myanmar's gas supply and demand balances. The second, and more intensive activity, will develop a empirical decision tool to forecast future demand and supply patterns and balances. This tool will be based on a simulation model developed from standards of the most recent natural gas system modeling. In this sub-section, we review the leading examples of this work, applications in three countries, and describe how we will adapt the leading example,

a model of natural gas development applied to Peru. This framework, implemented in Excel, will be delivered to MOE with complete technical documentation and an onsite training component.

23. In our overall supply-demand model review, the objective was to find studies that are relevant for assessing and comparing benefits of gas supply to both domestic and export markets, a key decision point for Myanmar authorities. Broadly, this methodology is situated in the realm of cost benefit analysis, financial modeling, and scenario assessments. These methodologies are broad enough that they can be applied to multiple commodities and geographies; in this summary, we have selected studies that focus on natural gas in countries that parallel Myanmar in terms of gas infrastructure and reserves. The summary is organized by country/region.

24. In this summary, we also describe the studies' use of the following information in their analysis, if at all, since such statistics are needed for the Myanmar study:

- Domestic gas pricing strategy
- Impact of international gas prices on gas export
- Government revenue from gas sector

3.1.3 Tanzania and Mozambique

25. In a study for the World Bank, Eberhard, Santley, and Schlotterer (2014) estimate what kinds of gas-to-power projects are economically viable in several key African countries. This summary focuses on their results for Tanzania and Mozambique over Nigeria, which differs very significantly in infrastructure from Myanmar.

26. The study estimates two prices, the minimum wholesale price and the LNG netback price, to recommend an export decision. The authors calculate the minimum wholesale price through a bottom-up discounted cash flow model that sums costs. The LNG netback price compares destination market price with total costs of distribution. For both Mozambique and Tanzania, the authors find that the LNG netback price is higher than the minimum wholesale price, indicating that export would be profitable. However, since Tanzania has a smaller resource base, the authors found that supplying gas to the domestic market would actually have a higher netback value. These findings on Tanzania are explored from a different perspective by Umeike (2014) below.

27. The World Bank study goes on to estimate the cost of electrification from natural gas versus other options, as well as the cost of building natural gas pipelines domestically and around the region. To estimate pipeline cost, which may be relevant for the Myanmar study, the authors assume a $64,300 per inch-kilometer heuristic for a simple discounted cash flow model. Demierre et al. (2015) also estimate the cost of regional distribution systems for gas from Tanzania and Mozambique; however, since export is assumed to be the most economical option, their methods are not summarized in detail here.

3.1.4 Tanzania

28. Umeike (2014) estimated revenue generating potential and direct economic value of various export and domestic consumption scenarios for Tanzania's recently discovered natural gas reserves. The paper considers three potential uses for Tanzania's natural gas: LNG export, urea manufacturing for export, or domestic electricity generation. These three scenarios were sub-models, each with three sub-scenarios, within the larger Excel-based scenario analysis model. In this summary, we focus on LNG export and electricity generation, which parallels the options for Myanmar's natural gas.

29. For the LNG and electricity generation sub-models, Umeike estimates exploration costs, capital investments, and government revenue (no private sector). The sub-model uses forecasted prices in the Asian LNG market, which is where Tanzania's exports would likely go. It assumes that the domestic price and international price are the same. For government revenue, the sub-model adds revenue from royalty payments with tax revenue, as determined by a simple algorithm.

30. For the electricity generation sub-model, Umeike models business-as-usual, gas-only, and low carbon scenarios. These sub-scenarios were differentiated by specific Levelized Cost of Electricity (LCOE) and Discounted Cash Flow (DCF) analyses. Also, instead of disaggregating transmission and distribution infrastructure costs, the sub-model uses energy prices to estimate the cost of power generation, as determined by Tanzania's tariff categories.

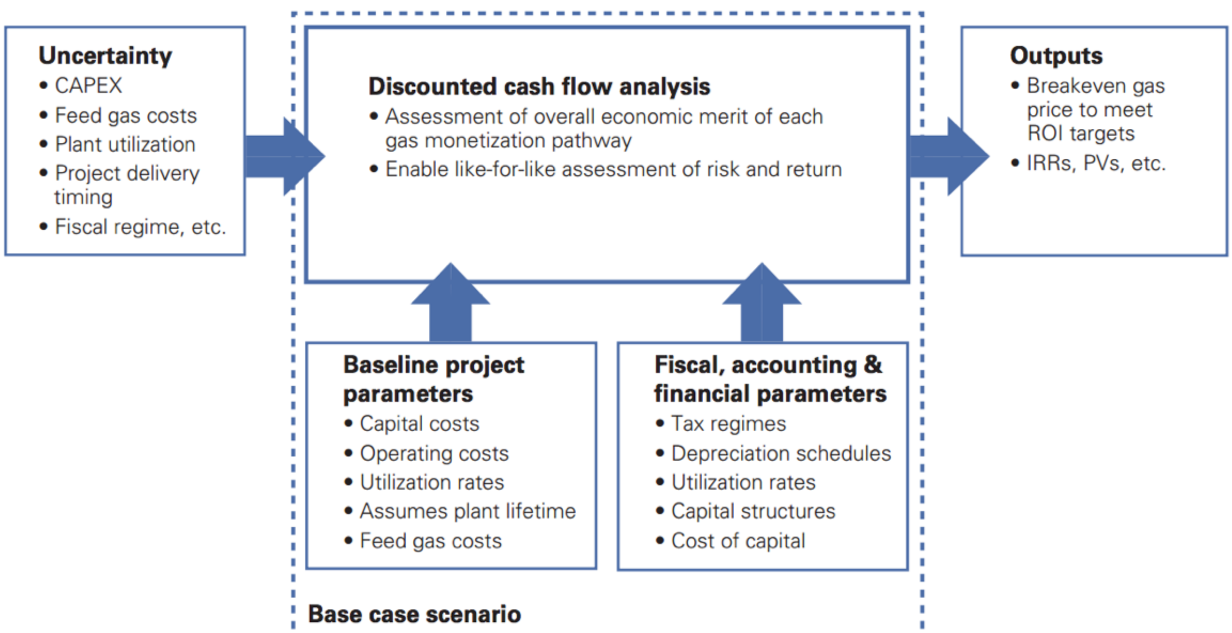
31. The paper projects that LNG export generates the greatest revenue, but that electricity generation produces the greatest direct economic value for Tanzania. This distinction is based on Umeike's additional calculation of 'value added per unit volume of gas produced', which the

author states corrects for different end-use market sizes and is a good measure of contribution towards GDP.

3.1.5 Cyprus

32. The MIT Energy Initiative is conducting an ongoing study on natural gas development in Cyprus. The first part of the study assesses project development options, all of which are export schemes, given the extremely small Cypriot gas market. Although Paltsev et al. (2013) do not conduct the study with an eye towards comparing domestic use versus export, they do provide a highly detailed discounted cash flow model (in Excel) that could be adopted to the Burmese context.[3] The output of their DCF model is the breakeven gas price ($/MMBtu), or the price at which the net present value of the project is zero and above which the project should be undertaken.

Figure 1: Estimating Gas Monetization Pathways with Discounted Cash Flow Techniques



[3] http://mitei.mit.edu/publications/reports-studies/interim-report-study-natural-gas-monetization-pathways-cyprus

3.1.6 Peru

1. Leung and Jenkins (2014) undertook a cost-benefit analysis for Peru to assess the difference in economic benefits for Peru with and without the Camisea gas fields LNG export project (which is already operating). Although Peru has a significantly more developed natural gas and electrification infrastructure than Myanmar, the methodology used here is the most advanced and relevant to the Myanmar project.

2. Leung and Jenkins calculate costs as a sum of tax revenue from the project, forgone tax revenues from domestic sales, and cost of energy to replace the natural gas once it is depleted. Government revenues and final consumer price of Camisea gas are sub-costs within these larger terms, with data available from project information. In both the with-project and without-project scenarios, the amount of natural gas supplied to the domestic market is the same; however, in the case of natural gas export, the gas reserves are depleted more quickly. Their financial model does not model the Peruvian natural gas distribution system in detail, but rather assumes a flat efficiency rate and heating value across the system. Off-take points are captured as aggregate demand in million cubic feet by client type – residential, industrial, electricity generation, etc.

3. The authors used the model to evaluate three scenarios. The first scenario simulates the information conditions in 2007, when Peru first decided to approve the Camisea project. The second scenario uses information at the time of the study, which showed that new reserves have been discovered but also that domestic demand for natural gas was increasing dramatically. Finally, the third scenario assumes implementation of oppositional policies that restrict export to certain blocks in the Camisea field.

4. Sensitivity analysis revealed that the most important factors in the model are domestic demand projections and the price of crude oil, a substitute for domestic natural gas, and that these factors drove the negative conclusion on the economic benefits of exports. T

5. It is clear that cost estimation for natural gas scenarios in Myanmar can benefit from the discounted cash flow modeling that others have used for similar scenarios. Fortunately, the open-source MIT DCF model and the financial model constructed by Leung and Jenkins (2014) can serve as starting points. Exact methodology will depend on data availability in Myanmar, in particular data on capital costs, domestic demand, prices, and government revenue policies. The

DCF model output should use an end metric that goes beyond gross revenue (value added per unit, for example), which should support the case for domestic use (Umeike 2014).

6. It is noteworthy that the studies summarized did not need to rely on spatial data or detailed grid information to estimate the well-to-turbine cost of domestic natural gas distribution. The globally accepted pipeline cost per kilometer in Eberhard et al. (2014) could be estimated for the Burmese context and validated with a price-based energy delivery model (Umeike 2014), depending on available data on domestic prices and tariffs in Myanmar. It should be noted that there is a large body of literature on natural gas monetization options that can be drawn upon for cost methodologies; however, many of these options are not feasible in Myanmar.

7. Finally, this summary could benefit from further exploration of methodologies that might be necessary for the Myanmar project. For example, Umeike (2014) states: "It is also worth noting that it was assumed that domestic industries will be set up close to the source of gas. As a consequence, value addition by gas distribution activities such as through pipelines were assumed to be negligible and so were not calculated."

8. The Myanmar project will require an understanding of how gas can be distributed from potential or existing off-take points in Myanmar's pipelines. For scenarios in which gas is used far from its source (small-scale rural electrification, for example), or in which significant new infrastructure is added domestically, we may need to think more deeply about how to model the value added from the distribution activities themselves. This could be a significant contribution to the overall value of domestic gas distribution over export.

3.2 Task 2: and Determine Methodology for Calculating Economic Costs for Domestic Gas in Myanmar

3.2.1 Task Description

9. There are various methods for determining the economic costs of natural gas, including a cost-plus approach. Task 2 shall determine the most appropriate method for calculating economic costs for the domestic market in Myanmar.

10. As part of Task 1 and Task 2 the Consultant will prepare an 'Analytical Report' that describes the gas supply and demand balance and sets out the proposed methodological approach for calculating economic costs for the supply of gas into the domestic market and outline the associated modeling approach to carry out Task 3.

3.2.2 Overall approach

11. In this Task, we shall examine alternative options of costing methodologies and identify the most appropriate one to ascertain the economic costs of gas transportation in Myanmar. Regardless of the chosen methodology, the determination of economic costs of gas up to the offtake points would require an assessment of two elements: upstream gas costs and transportation costs. There are alternative approaches and key prerequisites for the assessment of these costs. These will also be examined in Task 2.

12. The proposed economic methodology, as well as the approaches and prerequisites for its application, will be presented to and discussed with the Client, so that there is agreement on the analytical framework and the model that will be developed under Task 3. Specifically, an outline of each examined economic methodology will be presented to the Client (description of the methodology, pros & cons, examples of its application) together with a justification for the selection of the proposed methodology.

13. In addition, outlines of the alternative approaches for upstream gas costs and transportation costs, their pros & cons and examples of application, together with a justification for proposing specific approach(es), particularly as a result of the availability of data, will be presented to, discussed and agreed with the Client.

3.2.3 Methodologies for assessing economic costs of gas supply

Several approaches for assessment of the economic costs of gas supply can be applied. Within the context of this project we propose to examine the following approaches:

a. Cost plus pricing;
b. Short Run Marginal Cost Pricing;
c. Long run marginal cost pricing - Average Incremental approach; and
d. Long run marginal cost pricing - Perturbation approach.

14. **Cost plus pricing** is a well-known, simple and additive approach, whereby costs pertaining to production, transmission, and distribution etc of gas are added along with the desired rates of return, so as to arrive at a minimum price that enables the company to break even financially. However, cost plus prices are static and not forward looking, are calculated each year, and are subject to wide fluctuations depending on the yearly mix of costs.

15. According to standard economic theory, prices should be set at **marginal cost** (MC) since, in the absence of externalities, this maximises economic welfare. This is because such prices reflect the costs involved in providing an additional amount of output. Setting prices equal to MC means that users will continue purchasing extra units until it is no longer economically efficient to produce them at that price. MC based pricing therefore send signals to consumers and producers encouraging them to balance the benefits obtained by consuming a good or service with the costs of providing it.

16. Marginal cost pricing is a forward-looking concept. It depends on using estimates of future capital costs (or capital costs looking-forward) to calculate gas charges, rather than historical costs. However, a forward-looking perspective implies the existence of a long term capital plan for the supplier.

17. Marginal cost can be estimated in either a short-run (SRMC) or a long-run (LRMC) perspective. **The fundamental difference between SRMC and LRMC is the time frame under consideration** and the implications for the supplier's ability to adjust its production process to minimise costs. LRMC is used to signify the cost effect of a change in demand which would involve future investments for infrastructure and capacity, whereas SRMC takes capacity as given,

and relates only to changes in operating costs. LRMC is generally preferable over SRMC as the appropriate basis for cost-reflective pricing.

18. In practice the value of the LRMC is usually approximated by estimating how long run operating and future capital costs change if expected demand changes. There are two broad methodologies that are used to estimate the capital cost component of the LRMC for a market:

- the Average Incremental Cost approach (AIC); and
- the perturbation approach (also known as the 'Turvey' approach)

19. The **average incremental cost approach** estimates LRMC as the average change in forward looking operating and capital expenditure resulting from a change in demand. It can be summarised as follows:

1. Forecast average annual and maximum demand over the future time horizon;
2. Develop an investment plan for capacity and infrastructure expansion that ensures that supply can satisfy demand;
3. Estimate LRMC as the present value of the expected costs divided by the present value of the future demand supplied

20. The AIC approach is commonly used to approximate the LRMC for network businesses because it can be estimated using pre-existing expenditure and demand forecasts. The principal shortcoming of the AIC approach is that it uses average future capital costs to approximate the likely marginal costs associated with a change in demand.

21. The **perturbation approach** shares many of the same steps as the AIC approach but focuses on estimating how future capital costs vary as a consequence of an increment or decrement of demand. The perturbation approach can be summarised as follows:

1. Forecast average annual and maximum demand over the future time horizon;
2. Develop an investment plan for capacity and infrastructure expansion that ensures that supply can satisfy demand;
3. Increase or decrease forecast average and/or peak demand by a small amount and recalculate the investments needed to equate demand and supply; and
4. Calculate the long run marginal cost (LRMC) as the present value of the change in costs,

divided by the present value of the revised demand forecast, compared to the initial demand forecast.

22. The principal feature of the perturbation approach is that it directly estimates the change in demand as a consequence of small changes in demand, which most closely ensembles the theoretical 'marginal cost'.

23. To determine the most appropriate alternative, we shall explore the pros and cons of each methodology and their applicability in the Myanmar context, taking into consideration factors such as:

- The complexity of the methodologies;
- The appropriateness of the methodology for the state of development and characteristics of the gas supply and infrastructure of Myanmar (e.g. size of reserves and production availability, system capacity constraints, need for large capex etc.);
- The availability of data required to apply them.

3.2.4 Approaches for assessing upstream costs of gas

24. To calculate the upstream cost of Myanmar's NG (essentially its price at the entry point of Myanmar's gas transportation system), the following approaches can be used:

Approach 1 – Opportunity cost according to international NG prices

25. This approach uses the export price of Myanmar NG at its border, as a proxy for the upstream cost of NG. It is based on 'international opportunity' cost, i.e. firstly that the opportunity costs of consuming gas in the country would be the price Myanmar can secure for exporting its NG, and secondly that the export price of Myanmar NG would be at least equal to its upstream cost of NG. In order to estimate the upstream cost, the export price will be netbacked to the field, by subtracting the transit cost of gas from the field to the border.

Approach 2 – Cost according to PSA

26. In the case of cost according to PSA provisions, the upstream cost of gas is the weighted average cost of the gas corresponding to MOGE's share of the PSA and the cost of gas corresponding to the foreign partners' share. This takes into account that MOGE retains part of the PSA revenues (in the form of royalties, profit split, domestic discount etc), and therefore it is

as if its share of produced gas is retained at ‘zero’ cost. On the other hand, the remaining gas production accruing to foreign partners has a cost, taken to be the international opportunity cost calculated in Method 1. These assumptions will be checked and verified with MOGE during the course of the assignment.

27. The upstream cost of the PSA is calculated by the following equation:

$$P_{NG,i} = P_{INT,i} \cdot \frac{(Q_{INT,i} - Q_{D,i})}{Q_{TOT,i}} + P_{PSA,i} \cdot \frac{Q_{D,i}}{Q_{TOT,i}}$$

where

$P_{NG,i}$ is the natural gas price at the entry point of the Myanmar transportation system in year i

$P_{INT,i}$ is the export gas price (international opportunity cost) in year i, netbacked to the field

$P_{PSA,i}$ is the discounted price at which Myanmar buys natural gas for domestic requirements from its foreign partners in year I, in case of relevant PSA provisions

$Q_{TOT,i}$ is the total gas quantity produced by the PSA venture in year i

$Q_{INT,i}$ is the share of foreign partners in the gas quantity produced by the PSA venture in year i

$Q_{D,i}$ is the quantity of gas for domestic requirements bought by MOGE from the foreign partners in year i at a discount, in case of relevant PSA provisions

Approach 3 – Upstream costs Bottom Up estimation

28. This approach estimates gas upstream costs according to available cost data for Myanmar fields. Total upstream costs are the sum of finding costs and production/lifting/extraction costs for MOGE. A proxy for the long-run marginal upstream cost of gas is the life-cycle gas cost i.e. the cumulative costs over the life of the field divided by the gas produced until depletion. In the case of PSAs, costs and gas attributable to foreign partners will not be included in the estimation.

29. In addition, in case there are scenarios examined showing risks of depletion of gas reserves as a result of large local consumption and exports, a depletion premium can be calculated and added to LRMC of upstream gas costs. In case indigenous production is exhausted, gas would have to

be replaced by imported gas or another fuel source, and thus the depletion premium reflects the difference in long-run marginal costs between indigenous and imported gas or other fuel (e.g. imports of LNG etc).

30. The depletion premium for a given year can be calculated using the following relationship:

$$DP_t = ((PST-CS_t)\,(1+r)^t)/(1+r)^T$$

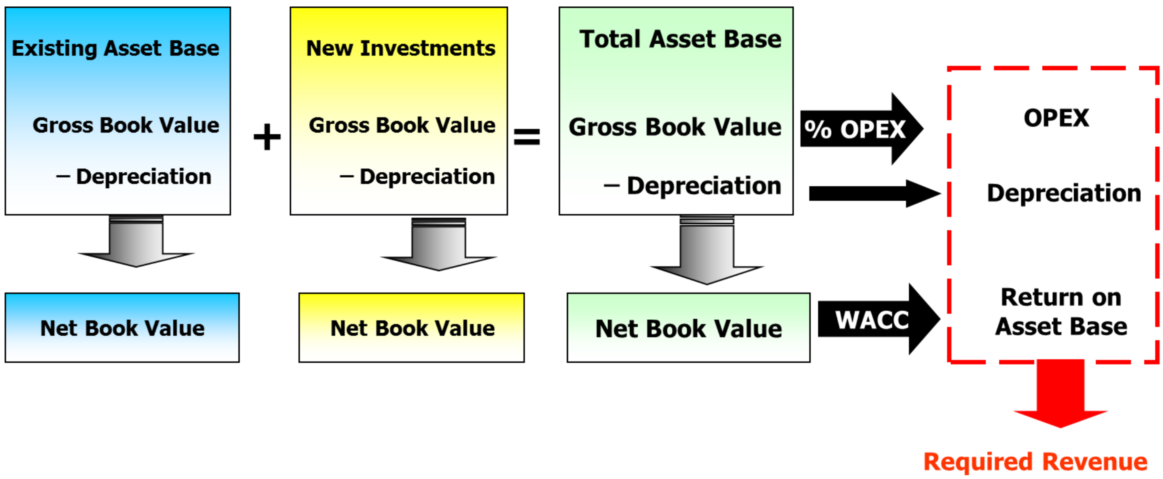
Where

r is rate of return
t is time
PST is the price of the substitute at the time of exhaustion
CSt is the extraction cost of present resource (assumed to be constant for all years)
T is the time of exhaustion of deposit.

3.2.5 Assessment of Transportation costs of gas up to the Off-take points

31. The calculation of the required revenue to cover transportation costs is straightforward and does not include alternative approaches (figure below).

Figure 2: Offtake Transport Cost Assessment



32. However, to calculate the transportation cost of NG until the off-take points, the following key information prerequisites have to be secured:

- Selected off-take points that are the subject of the economic costing analysis, customers connected to these off-take points and their demand characteristics
- Long term Investment plan for the upgrade and expansion of domestic transportation system infrastructure
- Identify (and exclude from calculations) transportation system section(s) dedicated to exports
- Allocation of costs between domestic off-take points and export routes, in cases where infrastructure is jointly used. The driver for this allocation should be the daily peak capacity of the domestic gas consumers connected to the target off-take points
- Determination of the target Weighted Average Cost of Capital (WACC) for MOGE

In case these are not available, the Consultant will agree relevant assumptions with the Client.

3.3 Task 3: Calculation of Economic Costs at Offtake Points from the Gas System

3.3.1 Task Description

33. The Consultant will calculate the economic costs at certain offtake points from the gas network on the basis of forecasted demand scenarios, and on the methodology and modeling approach proposed under Task 2. Estimating economic costs will require a detailed assessment of current and future: (1) Gas production costs (calculated at the inlet to the transmission system); and (2) Gas transportation costs (at certain offtake points from the gas network).

34. To assess and evaluate current and future gas production costs in Myanmar, the Consultant will take into consideration all relevant cost data, including off-shore deep and shallow water model Production Sharing Agreements (PSAs), E&P costs, volumes of gas produced and forecasts, revenues and operating costs linked to each field. The Consultant notes that although there is information on investments, costs and gas production and forecasts related to onshore fields, there is absence of information on onshore PSAs (if applicable). The data will be clarified with MOGE.

35. To calculate gas transportation costs at certain offtake points the Consultant will be provided with relevant network information and data by the MoE and the gas transportation companies.

36. The number of offtake points will be determined in close cooperation with the MoE but will include offtake points at major consumers, including power stations and large industrial users. The Consultant will also calculate economic costs of supplying other customers in various gas distribution areas. In modeling/calculating those costs the Consultant will prepare a sensitivity analysis. A preliminary list of off-take points to be discussed and finalized with the client is presented in the table below.

Table 3: Actual and Potential Offtake Points

No.	Name	Sub-system	Type	Estimate
1	Kyaupyu	Shwe 40"	Offtake	✓□
2	Yenangyuang	Shwe 40"	Offtake	✓□
3	Tuangtha	Shwe 40"	Offtake	✓□
4	Belin	Shwe 40"	Offtake	✓□

5	Chinese Border	Shwe 40"	Border	✓
6	Kanbauk	Kanbauk 20"	Industrial	✓
7	Thai Border	Kanbauk 20"	Border	✓
8	Ngantay	Kanbauk 20"	Industrial	✓
9	Myaingalay	Kanbauk 20"	Industrial	✓
10	Thanlyin	Kanbauk 20"	Industrial	✓
11	Thanlyin	Kanbauk 20"	Gas Turbine	✓
12	Akine	Kanbauk 20"	Gas Turbine	✓
13	Ywama	Yadana 24"	Industrial	✓
14	Hiewge	Yadana 24"	Gas Turbine	✓
15	Myaungtakar	Yadana 24"	Industrial	✓
16	Thabaung	Thabaung 10"	Industrial	
17	Kangyidaung	Thabaung 10"	Industrial	
18	Pathein	Thabaung 10"	Industrial	
19	Kiangjn	Shwepyithar 8"	Industrial	
20	Seikthar	Shwepyithar 8"	Industrial	
21	Shwedaung	North-South 14"	Industrial	
22	Kyawswa	North-South 14"	Industrial	
23	Kyauk Swe Gyo	North-South 14"	Industrial	
24	Yone Selk	North-South 14"	Industrial	
25	Yeni	Yeni 12"	Industrial	
26	Nay Pyi Taw	Yeni 12"	Industrial	
27	Nay Pyi Taw	Yeni 12"	Gas Turbine	
28	Taungpila	Taungpila 8"	Industrial	✓
29	Pyi Nyaung	Tuangyi 20"	Industrial	✓
30	Taunggyi	Tuangyi 20"	Industrial	✓
31	Sarkhar	Kyauske 20"	Industrial	✓
32	Kyaukse	Kyauske 20"	Industrial	✓

37. For prospective (not yet built) offtake points, we could estimate costs as long as the hypothetical locations allow for responsible interpolation or extrapolation to estimate costs from existing data. We currently propose estimation of costs for all points with pipeline service equal or exceeding 20 inches.

3.3.2 Overall approach

38. In this Task, we shall apply data collected in Task 1, and the methodology and approaches for upstream and transportation costs selected in Task 2, to calculate the economic costs for supply of gas to agreed domestic off-take points in Myanmar.

39. Gas demand forecasts (energy demand and daily peak) at each off-take point will be used. In case these are not readily provided by the client, they will be estimated by the Consultant. The basis for estimation will be:

1. For electricity generation, the long term electricity master plan that analyses the operation of existing and planned power plants and provides gas demand forecasts. Electricity peak demand forecasts for Myanmar (driving peak gas demand for gas fired stations) broken down by region are available. The contribution of each gas fired power plant to the peak will be based on merit orders assessed in the masterplan and the capacity of each power plant.

2. For industrial demand or for other types of demand if present e.g. a city connected to an offtake point that includes commercial/business customers etc. we will utilize available gas demand forecasts; where these are not available, we will project histrorical gas demand based on GDP growth assumptions agreed with the client. In case historical peak demand is available for each industry, it shall be used to determine contribution to overall peak demand; in case historical peak demand is not available, broad assumptions, e,g, by applying a factor to increase average daily demand so as to calculate peak demand will be developed, in agreement with the client.

3. For CNG demand, if present, i.e. off-take points linked to CNG stations providing gas to transport vehicles, the demand forecasts of the energy master plan will be

used, For peak calculation purposes, it is proposed to assume an even distribution of CNG demand throughout the year, day, hours – unless more detailed is provided by the client

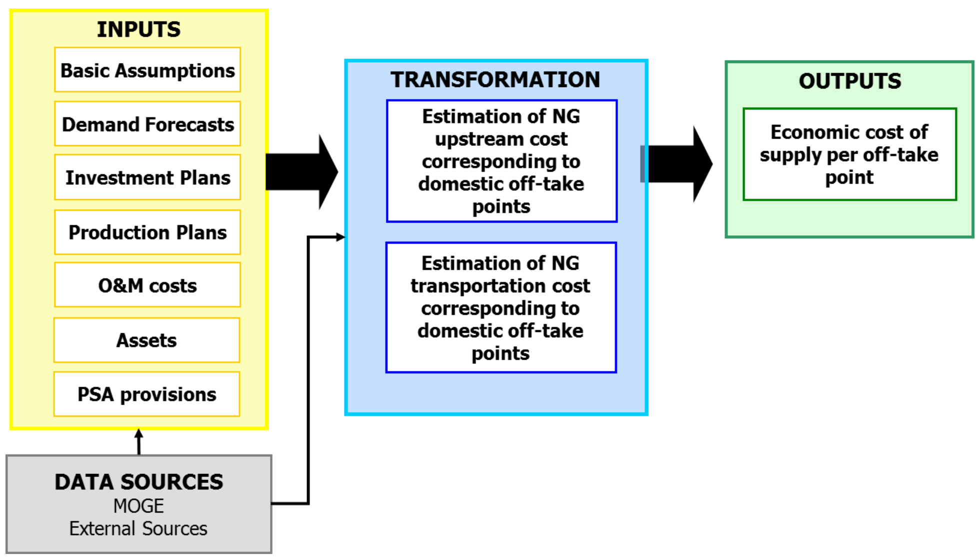
40. To assess the sensitivity of costs at the offtake points to changes in demand, we will use alternative scenarios related to gas demand, especially in relation to the implementation of new gas-fired thermal power plants, the development of gas demand at the special economic zones and the development of new gas transmission infrastructure. Scenarios shall be agreed with the Client and applied in the model.

41. A tailored natural gas costing model for the market of Myanmar shall be developed, so as to efficiently and effectively perform the required analysis and calculations for the economic costs.

3.3.3 Natural gas costing model

42. The model will be composed of three main blocks with the logical flow of “input-transformation-output”, as presented in the figure below. The model will be developed in Excel and provided to MOGE.

Figure 3: Natural Gas Costing Model



43. As the natural gas costing model is a deliverable of this project, we shall ensure that it is user-friendly and appropriately structured. A Users' Guide shall accompany the model delivered to the Client, describing its modules, key functions and mode of operation.

3.4 Task 4: Estimate the potential impact of a decline in gas prices and increased domestic supply on the value of exports and government revenue

3.4.1 Task Description

44. The consultant will estimate the impact of declining gas prices and increased domestic supply on government revenue based on production data compiled under task 2, different gas price assumptions,[4] and assumptions on domestic supply under tasks 2 and 3.

45. The consultant will prepare a mapping of financial flows in the gas sector including: proceeds from exports and domestic sales for MOGE and foreign operators (including applicable production

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[4] Gas prices for exports are indexed to heavy fuel price (50 percent) and other indicators reflecting costs of production. Gas prices are revised every three months, assessing the average of these factors over the past twelve months. Gas prices for domestic sales are administered.

sharing and pricing arrangements); and all tax and non-tax receipts (signing bonus, royalties and any other) from the gas sector.

46. The consultant will use the above mapping to work with MOE and the Ministry of Finance to prepare a simple excel-based model that helps to match historical accounts on tax and non-tax receipts from the gas sector to available historical information on gas production and prices.

47. The consultant will use this model as a basis to project government receipts using production estimates in task 2 and different price and domestic supply assumptions. This framework should also enable the team to extract information on the value of future export proceeds.

48. Consultant will submit a detailed report together with hard and soft copies of the supporting documents, calculations and models.

3.4.2 General Approach

49. In this task, we proposed a financial model capable of forecasting government revenue from tax receipts and other sources of revenue from the Myanmar gas industry. The model was to provide a financial mapping and trace all tax and non-tax incomes from gas sales and exports.

50. As we understand, the purpose of this model is to help the Myanmar government gain an understanding of projected revenue from the gas industry and make key policy decisions in a changing macro environment. Thus, the model will be designed to provide revenue forecasting under various pricing and policy scenarios. The model will help with, for example, setting the right tax rate in a particular gas price environment or the right gas price for domestic market supply whilst ensuring commercial viability for both the upstream and midstream business.

51. In order to ensure the model is fit for purpose and accurate, the following list of data, as requested previously, will be necessary:

1. Studies and data requirements regarding gas supply and demand:
    a) Historical, current and forecasted gas production. Historic data for gas production (annual and yearly peak) should be by field
    b) Historical, current gas exports, forecasted exports based on commitments/contractual arrangements and plans/targets

c) Historical, current gas exports in spot markets
d) Historical, current domestic gas supply, and projected availability of gas for domestic use
e) Gas Prices – export and domestic gas price formulas and historic prices

2. Studies and data requirements regarding cost of gas production, transmission, distribution and supply:
   a) Gas production (dry) historic and future costs for each gas field (existing or new) broken down by main cost component (exploration & development costs, O&M costs (materials and labour), gas processing and treatment costs (wet to dry), capex, assets depreciation rates, net book value, royalties and taxes (if not included in the PSAs))

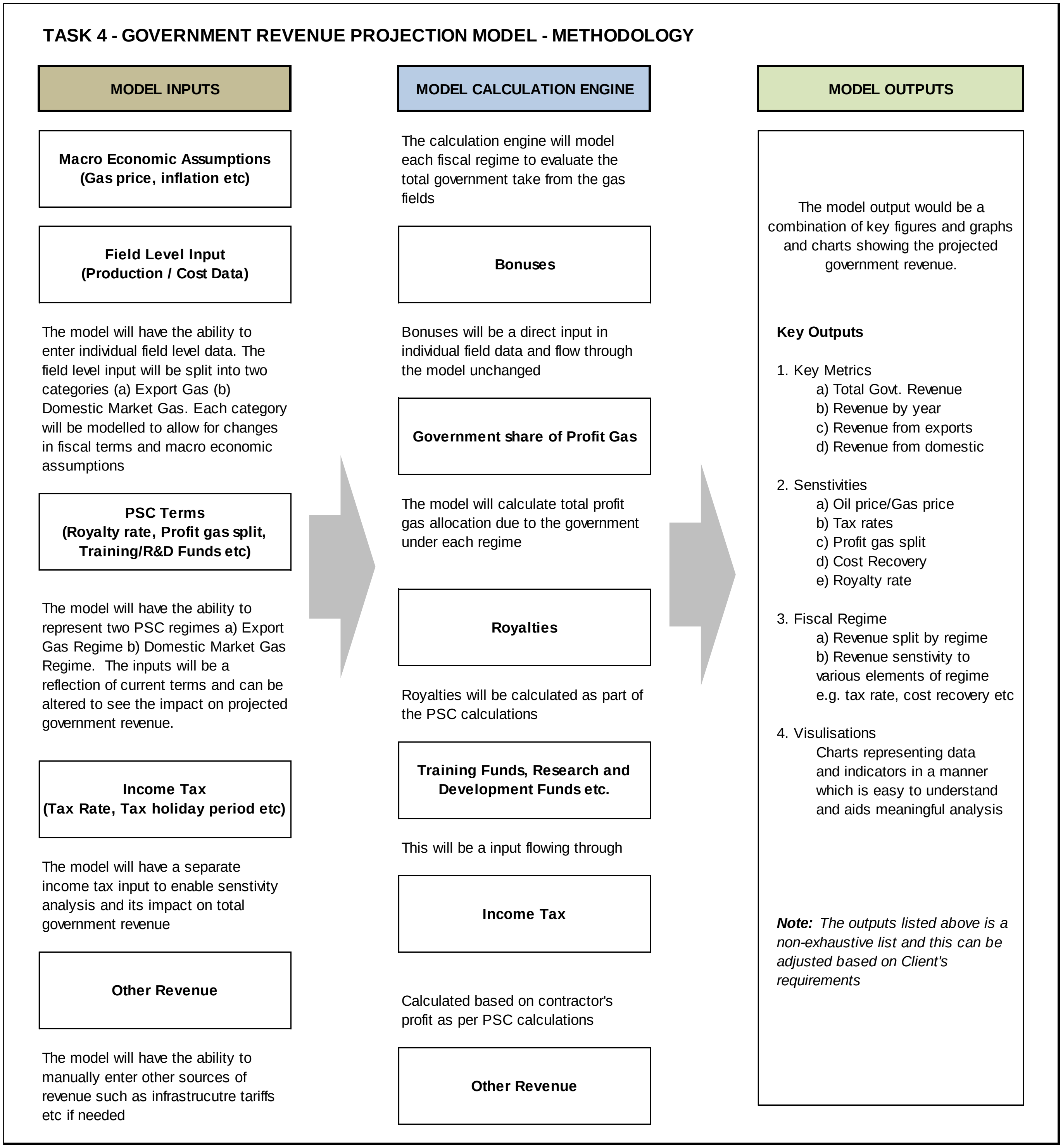
3. Economic/financial/fiscal data requirements:
   1. Current and planned Production Sharing Agreements (PSAs) with gas producers. Key terms like Profit Gas Share, Cost Recovery etc
   2. Corporate tax rate, current and projections
   3. Local currency exchange rate to USD, projections
   4. Depreciation rates for assets

52. The key to a comprehensive model which accurately represents forecasted revenue is the quality of data on current/future fiscal terms as well as field level data. We understand some of the requested data requests have been fulfilled and hope to receive all the information prior to commencing work.

3.4.3 Methodology and Model Structure

53. The methodology and structure of the proposed revenue projection model is summarised in the flow-diagram, followed by a detailed description.

Figure 4: Schematic of the Government Revenue Model



3.4.4 General Structure of the Model

The model will consist of three main components, namely a) the Input Module b) the Calculation Module and c) the Outputs Module. It will be designed in MS Excel with limited VBA code and macros in order to keep within the remit of a simple and easy to use model.

The model will be designed around two fiscal ‘regimes’ – namely the Export Gas regime and Domestic Gas regime. This is to help identify and analyse the two fundamental markets individually from a policy perspective. This would help with testing different tax rates and gas prices for domestic market as they generally differ from the export market to help support local development.

The user will be able to enter key input assumptions separately for each of the regime in order to compare and accurately forecast the projected revenue for the Myanmar government.

However, as the Myanmar government operates a Production Sharing Contract fiscal system, the ability to forecast and accurately history match government revenue will be difficult to achieve. This is mainly due to the individual nature of PSCs as they have different terms and must be modelled on a field by field basis in order to generate the government take from individual contracts.

For the purpose of this model, a ‘typical’ Myanmar PSC will be modelled for the export gas and domestic gas regimes which are most representative of current and future terms. The consultant will attempt to history match as closely as possible to the government revenue when designing the pseudo PSC terms.

3.4.5 Input Module

The input module will be designed to contain all user inputs. These would include:

- **Macro-economic assumptions** (oil price, gas price, inflation, discount rate, conversions etc) The gas price in the input module will be entered separately for the export market and domestic market as they would be expected to be different. Users will have the ability to alter input values in order to see the impact on government revenue projections.

- **Field level input**
    - Production profiles by field
    - Exploration, development and operating costs by field

In addition to field level data, the user will have the ability to assign a percentage of the production and cost to the individual regime e.g. 30% of Field A goes to domestic market and 70% to export. This will be designed to enable part allocation of gas fields and run sensitivities if necessary.

- **PSC Terms**
    - Export Gas Regime – key terms (royalty, profit sharing terms, cost recovery mechanism, bonuses, state participation, funds contribution etc)
    - Domestic Gas Regime – key terms input options will be same as Export Gas regime, however, the values will differ as necessary

  The PSC terms will be the fundamental driver of the calculation engine in the model. The terms entered at the input level will determine the total government take from the sales of gas at both the domestic and export level. Users can alter the terms and see the direct impact on government revenue projection

- **Tax assumptions**

  The key inputs will include
    - Tax rate
    - Tax holiday period (currently 5 years)
    - Asset depreciation rates

- **Other Revenue**

  This input option is designed to allow the user to manually enter any other sources of government revenue by year, which they would like to see in the output reports. It will simply flow through the model with no calculations.

3.4.6 Calculation Module

The calculation module will be designed to project the revenue Myanmar government would expect from all the fields.

As Myanmar operates a PSC regime, the sources of revenue are not what are typical of a corporate tax regime. In a PSC regime, sources of revenue can be:

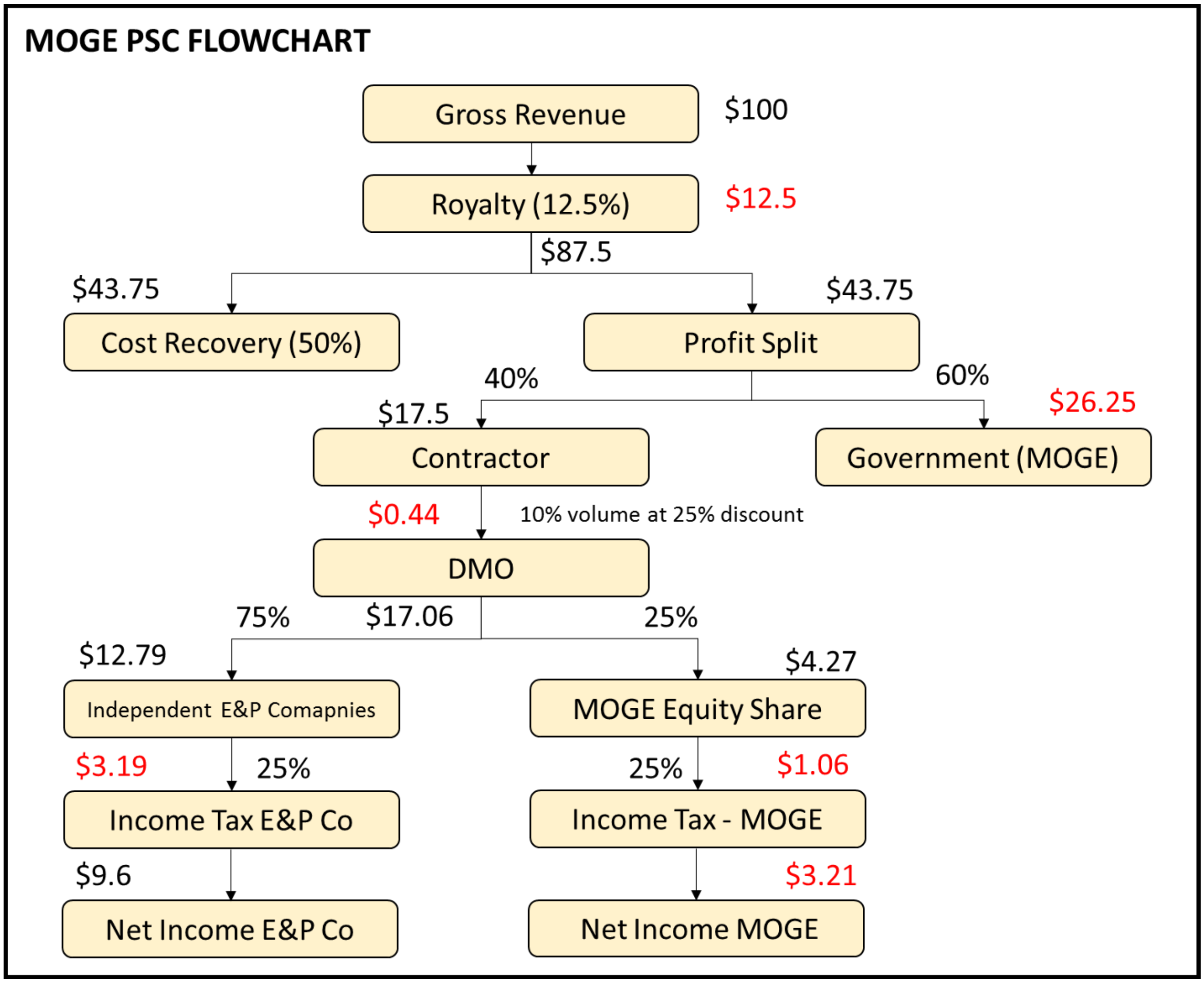
- Royalty
- Bonuses
- Government share of profit oil/gas
- State participation
- Training Funds/ R&D Funds
- Corporate Tax

The chart in Figure 5 below is a representation of a typical Myanmar PSC as provided by MOGE. The government revenue elements are highlighted in red and will form part of the proposed model. It is important to note that the total government revenue for the purpose of this model will include Royalty, Government's share of profit oil, DMO discount revenue (deemed), Taxes from the independent E&P companies and MOGE's equity share as well as MOGE's equity share net income. It will not include the cost recovery share of MOGE.

54. For the purpose of this model, the aggregation of government revenue will be calculated based on the key terms of the current and proposed PSC contracts. The model will attempt to calculate each of these elements based on a pseudo PSC for the export gas and domestic gas regime. Each regime will have set values on key parameters like the cost recovery limit, profit share percentage, royalty rates, bonuses and state participation. This will help determine the expected revenue from each of these revenue sources. Similarly, the corporate tax rate will also be set individually for each regime (export and domestic) at the input level. Thus, the model will aggregate all the field level data into a single gas field which will be run through the calculation engine for all PSC and tax calculations.

55. It must be noted that this methodology differs from real-life scenario i.e. typically each field or block will have individually negotiated PSC terms and potentially varying tax treatment. However, reflecting each field PSC terms individually is difficult to achieve in a single model and makes the model complicated, difficult to audit and run. Moreover, this approach would require continuous modelling of new PSC terms for new fields in order to maintain accuracy of forecasts. Keeping in mind the request to keep the model simple, the methodology outlined above is being adopted.

Figure 5: PSC Revenue Flow Chart



56. A further simplification in the model will be the tax paying position of all gas field producers (contractor companies). All companies will be assumed to have a tax paying position i.e. no tax pool will be developed or carried forward. This would enable the aggregation of all field data more plausible. The downside of this approach is that it will result in over estimation of government revenue in years where large capital spends occurs on individual fields which may have no tax liability. However, the alternative option of calculating the tax at individual field level, as discussed earlier, will not be achievable for this task.

57. Lastly, in the calculation module, despite the field data being aggregated for tax and PSC calculation purposes, the economic limit for each field will be calculated individually in order to

appropriately truncate their field life. The economic limit will be calculated on the basis of cumulative operating cash flow (revenue minus operating costs).

3.4.7 Output Module

58. The output module will be designed and finalised by close interaction with the Client. The aim of the output module will be to represent the results of the model in a user friendly manner using charts and tables.

59. The proposed outputs from the module are listed below:

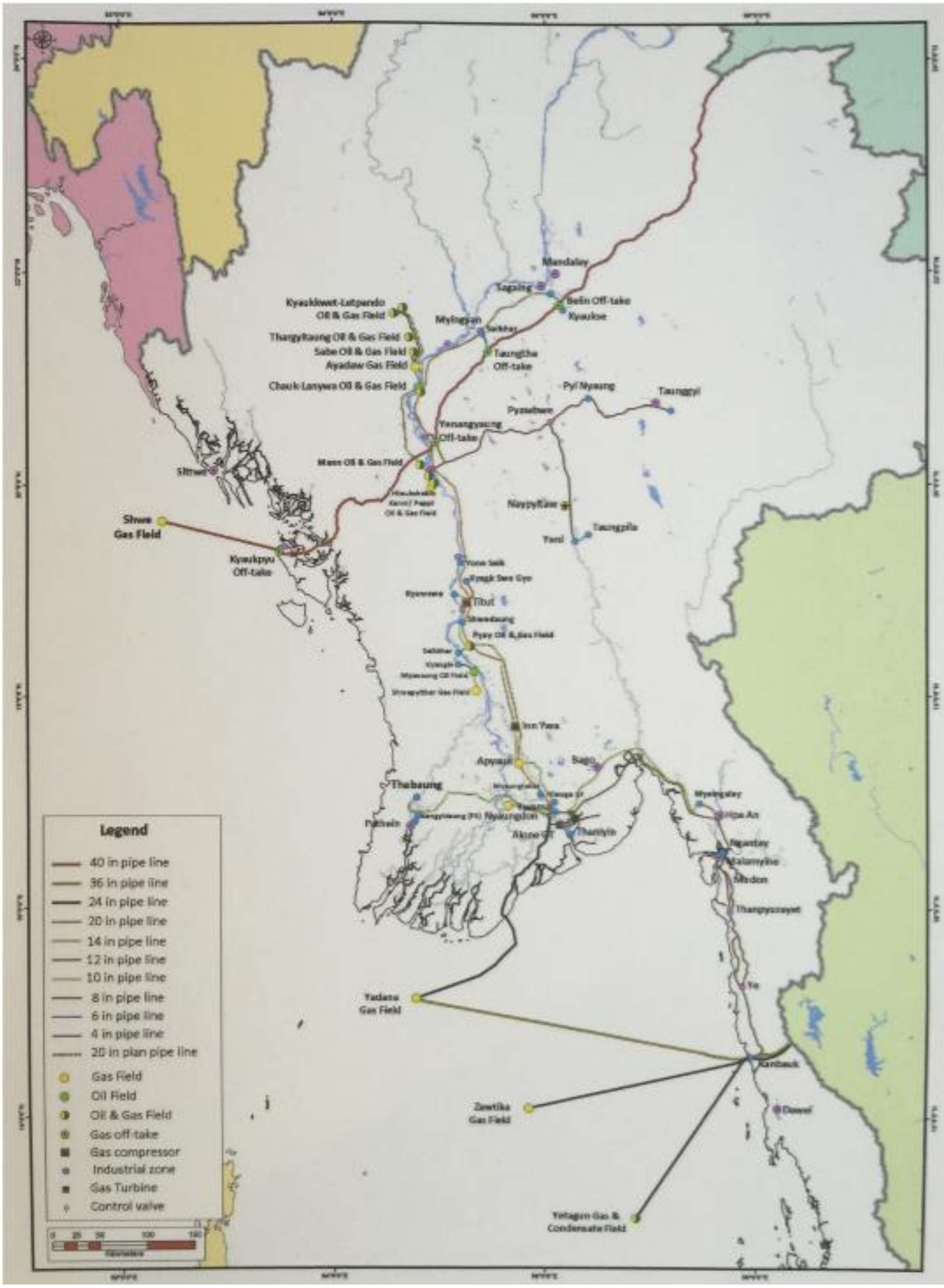
- **Key Metrics** – Historic and projected government revenue by year and other categorisations as the Client see appropriate. Key metrics could also include PV revenue, total government take etc.
- **Sensitivities** – Ability to test sensitivity of specific input parameters and their impact on projected revenue. These could include oil and gas prices, tax rates, PSC terms and royalty rates etc.
- **Fiscal Regime** – Output metrics which highlight the regime specific parameters and revenue generation from each element e.g. revenue by royalty, profit gas split, taxes, bonuses etc. Sensitivities specific to the fiscal regimes will also be captured in this section
- **Visualisations** - Charts representing data and indicators in a manner which is easy to understand and aids meaningful analysis

3.4.8 Delivery and User Guide

60. The methodology and model structure illustrated in this report is based on the assumption of data availability and current understanding of Client's needs. However, should this change, the model will need to be adjusted to reflect these changes. Nevertheless, any major deviation from this methodology will be communicated to the Client and agreed in advance.

61. As the revenue projection model is a deliverable of this project, the consultant will ensure that it has a simple structure and is user-friendly. A Users' Guide shall accompany the model delivered to the Client, describing its modules, key functions and mode of operation.

Myanmar's Existing Natural Gas Pipeline System



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5 ANNEX 1 – DATA INVENTORY

Summary of Data Availability by Format/Medium		Online	Electronic	Hardcopy	A	B	C	Value	Unit	Source(s)	Time Period	Source Link 1 (Dropbox/website)	Source Link 2 (Dropbox/website)	Source page	Remarks
1. Studies and data requirements regarding gas supply and demand:															
	1. Proven, possible and probable gas reserves.	1						Proven = 9.996, Probable = 16.72*, Possible = 18.549*	TCF	CIA Factbook, US Dept. of Energy, ADB Energy assessment	1/1/2014, *09/01/2011	https://www.cia.gov/library/publications/the-world-factbook/geos/bm.html	http://www.eia.gov/beta/international/data/browser/index.cfm#?iso=MMR&c=00000000000000000000000000001&ct=0&ord=SA&cy=2015&v=H&vo=0&so=0&io=0&start=2010&end=2015&vs=INTL.43-1-MMR-BCF.A&pa=g1q0000g0000100001004&f=A&ug=g&tl_type=p&tl_id=3002-A	http://www.adb.org/sites/default/files/institutional-document/33719/files/myanmar-energy-sector-assessment.pdf	E&D Offshore: They have the soft copy and will send us later.
	2. Latest gas reserves audit report. If a recent audit is not available, then up-to-date unaudited information on the proven, possible and probable		1					Yadana Gas Field: The Yadana field has estimated gas reserves of more than 5.7 TCF, with an expected field life of 30 years. It is operated by Total and started	TCF, BCF	ADB Energy assessment	9/1/11	http://www.adb.org/sites/default/files/institutional-document/33719/files/myanmar-energy-sector-assessment.pdf			Do

	reserves in Yadana, Yetagun, Shwe and the smaller on-shore fields. Information, inter alia, should include for each gas field reservoir depth, water depth, total reserves, expected peak production, ultimate gas recovery, estimate of developed and undeveloped field potential							production in 1998. Gas from Yadana is transported via a 346-kilometer subsea pipeline and a 63-km onshore pipeline to the border with Thailand at Ban I Thong. At the border, the Yadana pipeline connects with a pipeline built by Thailand, which carries the gas to its destination near Bangkok, providing fuel to the Ratchaburi and Wang Noi power plants. Gas from the Yadana field							

								covers an estimated 15%–20% of Thailand's demand for natural gas. The Sein field, located south of the Yadana field, is estimated to have recoverable reserves of 200 BCF							
			1					The Yetagun field has estimated reserves of 3.16 TCF. Following the withdrawal of Texaco in 1997 and Premier Oil in 2002, Yetagun has been operated by Petronas, in partnership with MOGE (20%), Nippon Oil (19%), and	TCF	ADB Energy assessment	9/1/11	http://www.adb.org/sites/default/files/institutional-document/33719/files/myanmar-energy-sector-assessment.pdf			

								PTTEP (19%). The gas is transported via a 210-km subsea pipeline and a 67-km onshore pipeline to Thailand.							
			1					In August 2000, Daewoo International partnered with MOGE to explore and develop offshore natural gas deposits in the Bay of Bengal off the coast of Arakan. In 2004, Daewoo International announced the discovery of the Shwe field, off the coast of Sittwe, the	TCF	ADB Energy assessment	9/1/11	http://www.adb.org/sites/default/files/institutional-document/33719/files/myanmar-energy-sector-assessment.pdf			

								capital of Arakan State. Test drilling in blocks A-1 and A-3 has indicated gas reserves of 3.56 TCF or more.							
	3. Current and planned Production Sharing Agreements (PSAs) with gas producers		1					The Yadana project was developed by a consortium composed of Total (31%), Unocal (28%), PTTEP of Thailand (26%), and MOGE (15%).		ADB Energy assess ment	9/1/11	http://www.adb.org/sites/default/files/institutional-document/33719/files/myanmar-energy-sector-assessment.pdf			Depends on the level of confidentiality
			1					PETRONAS 40.75 % NIPPON 19.40 % PTTEP 19.40 % MOGE 20.45 %		ministry_of_energy_myanmar_2_27_13.ppt	2/27/13				
			1					DAEWOO 51 % ONGE 17 % GAIL 8.5 %		ministry_of_energy_myanmar_2	2/27/13				

								KOGAS 8.5 % MOGE 15 %		_27_13.ppt					
	4. Historical, current and forecasted gas production. Historic data for gas production (annual and yearly peak) should be by field		1												Available
	5. Historical, current gas exports, forecasted exports based on commitments/contractual arrangements and plans/targets		1												Available
	6. Historical, current gas exports in spot markets		1												Finance
	7. Historical,		1												Available

	current domestic gas supply, and projected availability of gas for domestic use														
	8. Historical and current commercial and technical losses in gas production, transportation and distribution. Potential changes in commercial and technical losses as result of relevant actions			1											Available
	9. Historic data for the operation of the gas transmission and distribution systems		1					**I have the data on their pipeline network and their lenth, capacity. Nothing about daily							Available

	(daily inflows at each injection point and outflows at each off-take point)							inflow and outflow							
	10. Historic data for the operation of the export pipelines (daily outflows)		1					**I have the data on their pipeline network and their lenth, capacity. Nothing about daily inflow and outflow							Annual Data available, monthly and quarterly would have been nicer
	11. Detailed description and technical characteristics of gas infrastructure in Myanmar (including map). Infrastructure will include production platforms and gas processing		1												Some are available, some are not. Need to specify our needs. Offshore, pipline and the production departements are needed to be involved from the MoE.

	plants, gas transmission and distribution systems (length and diameter of pipelines, compression stations, metering & regulation stations, maximum and operating capacity of pipelines, location and capacity of injection and off-take points), export pipelines (length and diameter of pipelines, compression stations, metering & regulation stations, off-take points, maximum and														

	operating capacity)														
	12. Investment plans for development of new gas infrastructure (transmission and distribution systems, export pipelines, LNG terminals, storage facilities), with information including inter alia planned maximum and operating capacity, status of implementation, planned date commissioning. Available studies (e.g.			1											Management Level decision. Has to come from the top. Some information are in PSA.

	pre-feasibility, feasibility studies) for each planned infrastructure														
	13. Description of Myanmar’s key gas consumers (electricity production, industry, transport, distribution), their location, their typical daily load profiles in different months, monthly consumption		1					**information about key consumers and yearly consumption							Annual Data, MoG can provide bi monthly data.
	14. Gas demand forecasts per sector, including all scenarios,			1											Energy Master Plan, Energy Policy Draft

	key policies and drivers.														
	15. Agreed off-take points for calculation of gas supply costs to customers			1											to be decided
	16. Gas production (dry) historic and future costs for each gas field (existing or new) broken		1					**information about the total investment on the project							Finance
	17. down by main cost component (exploration & development costs, O&M costs (materials and labour), gas processing and treatment costs (wet to dry), capex, assets depreciation			1											Finance

	rates, net book value, royalties and taxes (if not included in the PSAs))														
	18. Thailand and China border with Myanmar gas prices	1									http://www.lexology.com/library/detail.aspx?g=858b5de9-43c4-4926-9e87-cc7d9b032fd9				Finance
	19. Gas transmission system capex/investment programme			1											Finance
	20. Gas transmission system assets (gross, depreciation, net)			1											Finance
	21. Gas transmission system O&M costs			1											Finance

	22. Gas export pipelines capex/investment programme			1											Finance
	23. Gas export pipelines assets (gross, depreciation, net)			1											Finance
	24. Gas export pipelines O&M costs			1											Finance
	25. Gas distribution system capex/investment programme			1											Finance
	26. Gas distribution system assets (gross, depreciation, net)			1											Finance
	27. Gas distribution system O&M costs			1											Finance
2. Other energy fuel and system data															

	1. Description of electricity sector of Myanmar (gas-fired power plants [type, capacity, year of commissioning, annual hours of operation, efficiency factor], other power plants [including RES]. Electricity peak demand, generating capacities, gross electricity production, transmission and distribution losses (commercial /technical), own power sector		1												From World Bank

	consumption														
	2. Electricity sector investment plans, and underlying rationale and drivers behind the investments to be made (efficiency of existing plants, new CCGTs, Open Cycle plants, network extensions etc) for validation of gas demand forecasts in the electricity sector (e.g. commissioning/decommissioning of plants, upgrades of existing plants, electricity		1												From World Bank

	system extensions, loss reduction plans, etc)														
	3. Description of use of CNG in transport (number of filling station and Natural Gas Vehicles, CNG price evolution, policies promoting the use of CNG)		1												Production and Engineering Department
3. Mayanmar Economic/financial/fiscal data requirements:															
	1. GDP, nominal, real, PPP, projections Inflation rate (CPI), projections		1												WB
	2. Population, growth rate and projections,		1												WB

	urban vs rural														
	3. GDP per head, average monthly salary		1												WB
	4. Monthly average energy cost, absolute terms and as a % of income), households vs industry			1				**information about household vs industry energy consumption but not in % income, that data can be calculated with enough information							WB
	5. Corporate tax rate, projections			1											WB
	6. Local currency exchange rate to USD, projections	1									http://www.xe.com/currencycharts/?from=MMK&to=USD	http://www.tradingeconomics.com/myanmar/currency/forecast			WB
	7. Depreciation rates for assets			1											WB
	8. Historic and current proportion			1											Finance

	of debt and equity in total liabilities of the gas operations of														
	9. Myanma Oil and Gas Enterprise, as well as the cost of debt and equity, broken down at production, transmission and distribution levels (for WACC calculation). In case WACC is regulated, the regulated WACC is sufficient for the analysis.			1											
	Financial data														
	Fiscal accounts														

	NIPA (C+I+G+X+M) by sector, commodity														
	Labor market data														
	Demographic data														
	Myanmar Economic and Foreign Trade Banks, audited accounts														
Totals	43	3	21	19											

Our Clients:

We are always available to answer any queries you may have.
Just contact at the address below.

e.Gen Consultants Ltd., Bangladesh
14 A Chandrashila Suvastu Tower
69/1, Bir Uttam Qazi Nuruzzaman Road, Dhaka 1205, Bangladesh
T: 880 2 9641256-9 F: 880 2 9641260-1 email: info@egenconsultants.com, web: www.egenconsultants.com